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Integrated Geoelectrical Resistivity and Geochemical Survey to Study Groundwater - a Case Study from Selangor, Malaysia

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SUMMARY

Integrated two-dimensional Electrical Resistivity Imaging (ERI) and hydrochemical surveys carried out to investigate and delineate a groundwater alluvial aquifer in the Kuala Langat, Malaysia. Resistivity method developed to investigate and delineate a groundwater aquifer in the Paya Indah Wetland. The electrical resistivity imaging surveys conducted to measures and maps of the resistivity subsurface materials. These techniques are applicable for the detection of subsurface formations, groundwater zones and also groundwater quality. A Wenner electrode array was successfully performed along and perpendicular together with length of 400 m and electrode space of 5 m. Chemical analysis of the groundwater samples from 5 boreholes were collected on May 2013. The region of fresh water is extremely obviously seen in the resistivity inverse model with the position around 20 m of depth. Results obtained from resistivity modeling as well as the hydrochemistry of the groundwater samples demonstrate that the soil and groundwater in the study area is a mixture of fresh and brackish water zones.

Introduction

Groundwater resources are considered essentially the most significant sources of water provide in the future. In numerous regions, groundwater is known as a significant water resource intended for both drinking and also irrigation aims. The study area is situated in the Kuala Langat area in the State of Selangor, Malaysia, which is approximately 60 km from Kuala Lumpur by road.

Following improvements in mathematical approaches, computer science as well as geophysical methods based on tomographic inversion had been utilized in shallow investigations. Geophysical investigation may provide an increasingly inexpensive approach to improve the understanding of several wells (Maillet et al., 2005). Electrical resistivity imaging studies determine the distribution of subsurface resistivity through measurements of the potential difference on the ground surface. Geoelectrical studies are employed frequently for groundwater investigations and have been used in various previous researches (Acworth and Dasey 2003; Sultan and Santos, 2008; Islami et al. 2012).

The model of geological conditions in the study area consists of the following four layers: (1) Layer 1: peat and peaty soil (Beruas Formation); (2) Layer 2: clayey soil (Gula Formation); (3) Layer 3: the Aquifer, alternatives of sandy soils/gravelly soil and clayey soil (lower member of Simpang Formation); (4) Layer 4: bedrock (Kenny Hill Formation). The main purpose of this research is to supplying accurate information to define the shallow aquifer and definition of the boundary between the fresh and brackish groundwater through the use of 2D electrical resistivity imaging and water quality evaluation.

Methodology

Electrical resistivity survey and chemical investigation are used to delineate the boundary between the fresh and brackish water zone in the study area. The wells were established in the area for groundwater quality monitoring. Field data were collected on May 2013. The primary goal of electrical studies is to look for the subsurface resistivity distribution through making measurements on the ground surface. Electrical resistivity imaging studies have been employed for several decades within geological, exploration as well as geotechnical investigations. In groundwater prospecting the electrical resistivity technique is the most successful and broadly used approach because to its efficiency in identify of water-bearing layers in addition to its convenience and affordable in the case of field research (Zohdy, et al 1974). ERI survey was performed using the ABEM Terrameter SAS 1000 with a multi-electrode switch system with 64 channels. The electrode spacing is 5 m with a total length of 400 m.

Result and Discussion

A maximum depth of 70 m is identified for the resistivity surveys. Figure 1 demonstrates a typical of pseudosection resistivity model. The upper part of the image in the range of 3.7 to 19.3 Ωm show good comparison with the surface clay layer. Underlain this layer of higher resistivity with a depth of about 20 to 30 m. Based on borehole information this second layer corresponds to sand with gravel and zones of more than 130 Ωm correspond to the bedrock surface which is at a depth of 30 m. The brackish groundwater boundary in the resistivity inverse pseudosection had been obviously shown in the figure 1. According to the obtained results from the model resistivity values fewer than 20 Ωm are approximated to the saline water and more than 20 Ωm approximated to the fresh water regions. Figure 2 shows that a piper diagram which was created for study area by utilizing the analytical data obtained from the chemical evaluation.

Conclusions

Electrical resistivity imaging and hydrochemical analysis are effective approaches to study subsurface and identification of the boundary between the fresh and brackish groundwater in the study area. The bedrock and aquiferous sand and gravel zones, which are located below the clay layer, were

mapped during the research. Electrical resistivity model with well information and the geological units have been effectively matched.

Figure 1 Selected 2D resistivity inverse model of the apparent resistivity data.

Figure 2 Piper diagram of the hydrochemical analysis data of the water samples collected from boreholes in the study area.

Acknowledgements

This work was supported by the University of Malaya under research grant PV112-2012A.

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